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STEEL WATER TANKS for PUBLIC SERVICE

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for Public Service

Pittsburgh-Des Moines Steel Company

Pittsburgh . Des Moines

Works of the
PITTSBURGH-DES MOINES
STEEL CO.
Pittsburgh, Pennsylvania

Steel Tanks *for* Municipal Water Works

NOTHING more clearly indicates the progress of a community or village than the installation of an adequate and a properly designed water works. The first essential of such a system is an abundant supply of good water available at all times. In order to procure such a supply it usually necessitates the installation of machinery to pump and store it.

The earliest storage reservoirs were built of masonry in the ground. This construction was soon abandoned because it was difficult to find a suitable elevation in most towns to provide an adequate pressure. Elevated reservoirs were then used of which the first were wooden tanks on wooden supports, followed by steel tanks and steel supports. The first steel tanks were made of flat bottoms as is customary with wooden tanks. This plan was very costly and for the first time in 1894 the bottoms were made hemispherical which type of design has been generally adopted since that date as the most satisfactory for service and the most economical.

The superiority of steel over any other material for the construction of these water towers is easily established. A well designed all-steel structure which will neither leak, rot nor burst, constructed by experienced manufacturers and erectors who make a specialty of these structures will prove most economical when cost of maintenance and length of life are considered.

In consideration of the installation of a new water works system with an elevated steel water tower, the large annual saving in reduced insurance rates is often a determining factor.

Steel tanks of any capacity up to a million gallons elevated on steel towers to give the required pressure may be designed and constructed to meet the requirements of a village or municipality. Pittsburgh-Des Moines water towers are in service in all parts of the United States and in many foreign countries.

City Water Works, St. Thomas, Ontario.
Capacity 600,000 gallons. Height 131 feet to Top.

Above is shown one of the largest elevated steel tanks in Canada, manufactured and erected by the P. D. M. S. Co.

Water Storage

MANY municipal water works systems have an inadequate supply of water available at a head sufficient to give the desired pressure. A large capacity pump is sometimes installed pumping directly into the mains. This however requires the installation of machinery to take care of the maximum requirements for the day, and this machinery is idle a large part of the time.

A more economical arrangement is the installation of a smaller capacity pump with an elevated tank. This gives a more uniform pressure and provides a reliable protection against fire by having available a supply of water stored at an elevation above the highest buildings of the village.

The capacity of the tank for a village water supply system should be carefully determined. Assuming the daily per capita consumption for domestic purposes to be fifty gallons which is a fair figure for an average town, the total daily consumption can readily be estimated by multiplying by the number of people served. To this should be added the quantity required by the manufacturing and commercial interests of the village and also the amount used for public purposes such as fountains, street sprinkling, etc. A common assumption then is that the tank will be pumped full twice a day making necessary a storage capacity of one-half of this amount.

If a fire occurred at a time in the day when this storage was nearly used up it would be necessary to add to this storage capacity the water estimated to sufficiently protect against a bad fire. This amount is easily obtained by referring to the tables on page sixteen and reading off the discharge from the nozzles used under the existing pressure.

To meet the requirements for municipal water supply systems the elevated steel tank has been found the most satisfactory. Structures of other materials are without exception unreliable and troublesome. A steel tank does not rot, leak, burst nor crack. It is a long-lived monument to the good engineering judgment of those who authorize its erection.

City Water Works, New London, Ohio.
Capacity 50,000 gallons, Height 92 feet to Bottom.

This is a standard all-steel construction especially suitable for municipalities and public institutions.

Under Construction

Completed

City Water Works, Ocean City, Md.
Capacity 80,000 gallons. Height 59 feet to Bottom.

CONTINUOUS service was necessary during the construction of the above tank and tower to increase the storage capacity for the Ocean City water works. This reservoir supplied the village with water for domestic use and for fire protection. The service could not be interrupted for any length of time. There was no other site available so one of our engineers designed a new structure to be erected upon the same foundations.

The new tower, first ring of the tank and tank bottom were first erected inside of the old tower. Then at a time in the day when the pumps could adequately take care of the supply, the old riser pipe was cut, the new saucer plate with a new expansion joint slipped in and the pipe connected again. Service was continued using the partly completed new tank. The old tank and tower were then torn down and the new tank completed with no further interruption.

City Water Works, Crewe, Va.
Capacity 100,000 gallons. Height 50 feet to Bottom.

Because of the elevation of the site, a two-panel tower in this case was sufficient in height to give adequate pressure.

Humble Water Works, Humble, Texas.

Steel Risers

THE photographs on this page illustrate two different types of risers. The large riveted steel riser shown on the St. Vital tower is recommended for the extreme winters of Canada. During cold weather an insulating layer of ice forms inside next to the steel and leaves a free passage for the water through the center of the riser. Where the small diameter pipe is used a wooden frost casing may be erected around the pipe, the number of layers of sheeting separated by air spaces depending upon the latitude of the location

St. Vital, Manitoba.

Procedure for the Installation of a Complete Water Works

WATER Works plants are almost invariably constructed by municipalities with money secured by the sale of municipal bonds.

For the benefit of towns contemplating the installation of a water works, we outline below the usual method of procedure.

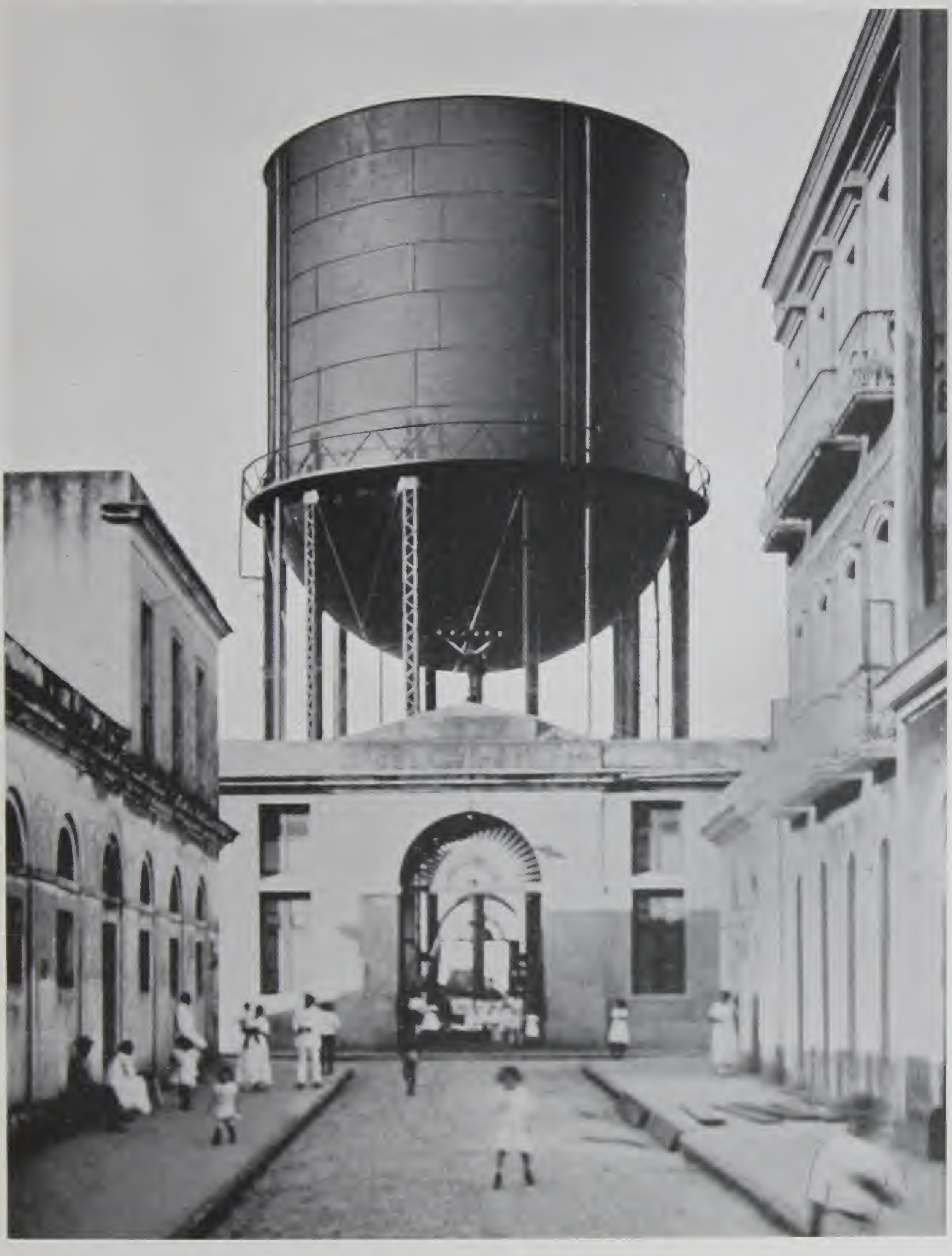
First: The Council upon determining that a water works for the town is desirable, should take steps to acquaint the voters with the nature, extent and cost of the proposed system. For this purpose, they should at once call to their assistance a practical Water Works Engineer to consult with them as to the system best adapted to serve the local conditions; then have prepared brief preliminary plans and an estimate of the cost, together with a report suitable for publication in a local paper. Thus the voters will be informed as to what can be expected for the amount estimated and consequently be able to vote intelligently.

Second: Call an election in a proper manner and vote on the proposition as prescribed by the Statutes. Extreme care should be exercised throughout to have all proceedings legal, and to keep full and proper records so that a complete transcript may be furnished when the bonds are to be sold.

Third: If the vote carries, have the Engineer get out complete, detailed plans and specifications and forms for proposals and contract.

Fourth: While this work is going on the bonds should be advertised and sold, so that if possible, the money will be in the treasury when the contract is let. No reputable contractor will start work before the bonds are sold.

Fifth: Advertise for bids and let a contract to a responsible contractor who has had experience in the class of work to be done. The award should be made only upon the basis of bids received in open, fair competition; otherwise the town will invariably be the loser. Pay a fair price, and get good material and honest service.



City Water Works, San Juan, Porto Rica.
Capacity 600,000 gallons. Height 42 feet to Bottom.

This is one of three Elevated Steel Tanks manufactured at our Neville Island plant and erected by us at San Juan. Our experienced erection crews are sent to all parts of the world.

Water Tanks for Cantonment

Aviation Tank

Pittsburgh-Des Moines Stee

ALL those who have seen the hills of France or perhaps only the dusty fields of a southern camp, like to recall the incidents which marked their experience during the great war. Why, then, should not an organization take the same pride in recounting some of its activities in the aid of the government during this same period? Besides flying a service flag with its quota of stars this organization served in the following ways:

Fabricated 12,000 tons of ship plates.

Erected three 600-foot Wireless Towers at El Cayey, P. R. and eight 820-foot towers at Bordeaux, France, the latter erection being carried on at present.

Manufactured and erected observation towers at Mulberry Island, Va., Aberdeen, Md.

Wireless Tower

Freight Carrier—Sea Going

teel Company War Activities

Erected water towers at—

Ft. Mifflin, Pa.
Ft. Des Moines, Ia.
Philadelphla Navy Yard
Cape May, N. J.
Harrison, N. J.
Arcadia, Fla.
Ft. Sill, Okla.
Norfolk, Va.
San Juan, P. R.
E. Columbus, Ohio
Allessandro, Cal.
Edgewood, Md.
Jeffersonville, Ind.
Aberdeen, Md.
Camp Holabird, Baltimore, Md.
Middletown, Pa.
Ft. Oglethorpe, Ga.
Millington, Tenn.
Ft. Worth, Texas.
Morrison, Va.
Lovefield, Dallas, Tex.
Lonoke, Ark.
Bergs, Tex.
Pike Road, Ala.
Newark, N. J.
Mineola, N. Y.

New York Athletic Club, Travers Island, N. Y.
Capacity 50,000 gallons. Height 50 feet to Bottom.

Steel tanks are most practical for clubs and all kinds of private and public institutions.

ELEVATED Steel Tanks may be used to the same advantage for all public institutions such as Hospitals, Farms, Prisons, Schools, Clubs etc. as in small communities. It is often necessary because of the location of such institutions to have an independent water system for domestic as well as fire protection. And in many

SOUMETHUN, TEXAS
SO. METHODIST UNIVERSITY
Capacity 100,000 Gallons
Height 68 feet to Bottom

ROCHESTER, N. Y.
HOMEOPATHIC HOSPITAL
Capacity 50,000 Gallons.
Height 100 feet to Bottom.

cases where the institution can arrange to receive supply from the city mains it is advisable to have water stored at an elevation in order to be independent of the town service in case of necessity. The service of our engineering department for installation of water works for a private water plant will be gladly furnished without obligation.

Useful Information

One cubic foot of fresh water, 62 degrees F. weighs 62.36 pounds

One United States gallon of fresh water weighs 8.33 pounds.

One cubic foot is equivalent to 7.48 U. S. gallons.

One U. S. gallon contains 231 cubic inches.

2.31 feet depth of fresh water will produce a pressure of one pound per square inch.

To compute the horse power required to elevate water to a given height, multiply the number of gallons raised per minute by 8.33 and by the total vertical height in feet between the surface of water in well and surface of water in standpipes or reservoir, and divide the product by 33000. Add from 60 per cent to 100 per cent for friction and other losses in determining size of engine.

CAST IRON PIPE
American Water Works Association Standard

Nominal Inside Diameter Inches	Class A 100 Ft. Head 43 Lbs. Pressure		Class B 200 Ft. Head 86 Lbs. Pressure		Class C 300 Ft. Head 130 Lbs. Pressure		Aprximate Lbs. Lead per joint 2 in. thick	Aprximate Lbs. Hemp per joint	Number of Feet per Ton		
	Thickness Inches	Weight per Foot	Thickness Inches	Weight per Foot	Thickness Inches	Weight per Foot			Class A	Class B	Class C
4	.42	20.0	.45	21.7	.48	23.3	7.50	.21	100.00	92.31	85.71
6	.44	30.8	.48	33.3	.51	35.8	10.25	.31	64.86	60.00	55.86
8	.46	42.9	.51	47.5	.56	52.1	13.25	.44	46.60	42.20	38.40
10	.50	57.1	.57	63.8	.62	70.8	16.00	.53	35.03	31.35	28.25
12	.54	72.5	.62	82.1	.68	91.7	19.00	.61	27.59	24.41	21.82
14	.57	89.6	.66	102.5	.74	116.7	22.00	.81	22.32	19.51	17.14
16	.60	108.3	.70	125.0	.80	143.8	30.00	.94	18.47	16.00	13.91
18	.64	129.2	.75	150.0	.87	175.0	33.80	1.00	15.48	13.33	11.43
24	.76	204.2	.89	233.3	1.04	279.2	44.00	1.50	9.79	8.57	7.16

Weights based on 12 foot lengths.

TABLE OF FIRE STREAMS

	¾ in. Smooth Nozzle or ⅞ in. Ring Nozzle					⅞ in. Smooth Nozzle or 1 in. Ring Nozzle					1 in. Smooth Nozzle or 1⅛ in. Ring Nozzle				
Pounds Pressure at Nozzle	20	30	40	50	60	20	30	40	50	60	20	30	40	50	60
Pressure at Hydrant with 100 ft. 2½ in. Hose	22	32	43	54	65	23	34	46	57	69	25	37	50	62	75
Vertical Height of Stream in Feet	33	48	60	67	72	34	49	62	71	77	35	51	64	73	79
Horizontal Distance of Stream in Feet	29	37	44	50	54	33	42	49	55	61	37	47	55	61	67
Gallons discharged per Minute	73	90	104	116	127	100	123	142	159	174	132	161	186	208	228

The above table is from experiments of J. R. Freeman, Trans. A.S.C.E.

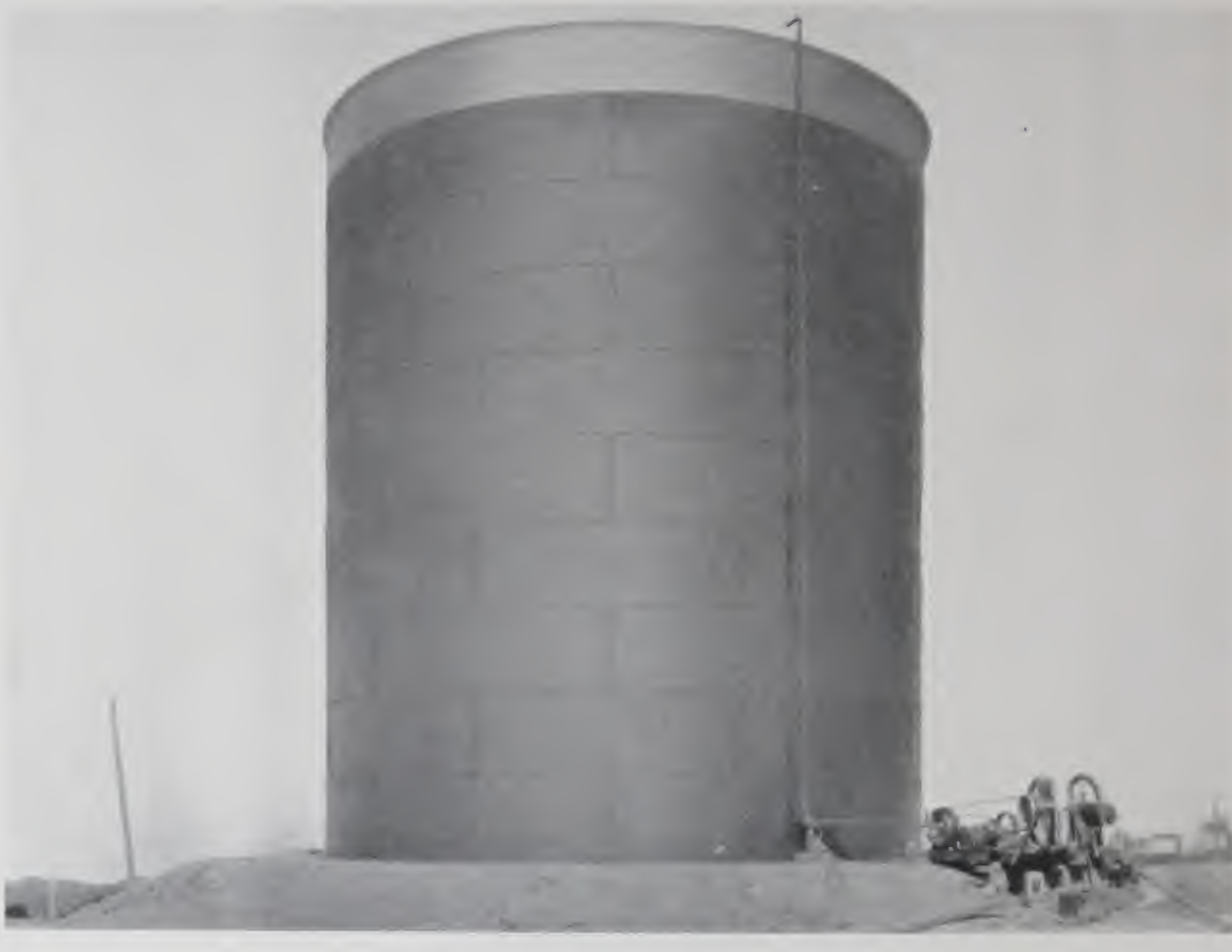
The vertical and horizontal distances are those of effective fire-streams with moderate wind.

The maximum limit of a "fair stream" is about 10% greater for a vertical stream, and 12% for a horizontal stream. In still air much greater distances are reached by the extreme drops.

The pressures given are for smooth rubber-lined hose.

Water Tower at Kasson, Minn.

This stone tower formerly supported a wooden tank which was replaced by us with this hemispherical bottom steel tank.



City Water Works, San Diego, Cal.
Height 53 feet. Capacity 493,500 gallons.

Standpipes

STANDPIPES are used as storage reservoirs for water systems in hilly country where they can be built on sufficient elevation to give a good fire pressure. It is not practical to use an elevation at a considerable distance from town because of the cost of additional underground piping and the loss of pressure in the extended main. To secure the greatest economy of material, standpipes should be built with a height not greater than the diameter. Very tall standpipes of small diameter are expensive because the useful capacity is only that part of volume which is at an elevation giving satisfactory pressure. The water in the lower portion serves merely as a support for that above. A more suitable and cheaper support is a steel tower.

Centralia, Mo., Water Works

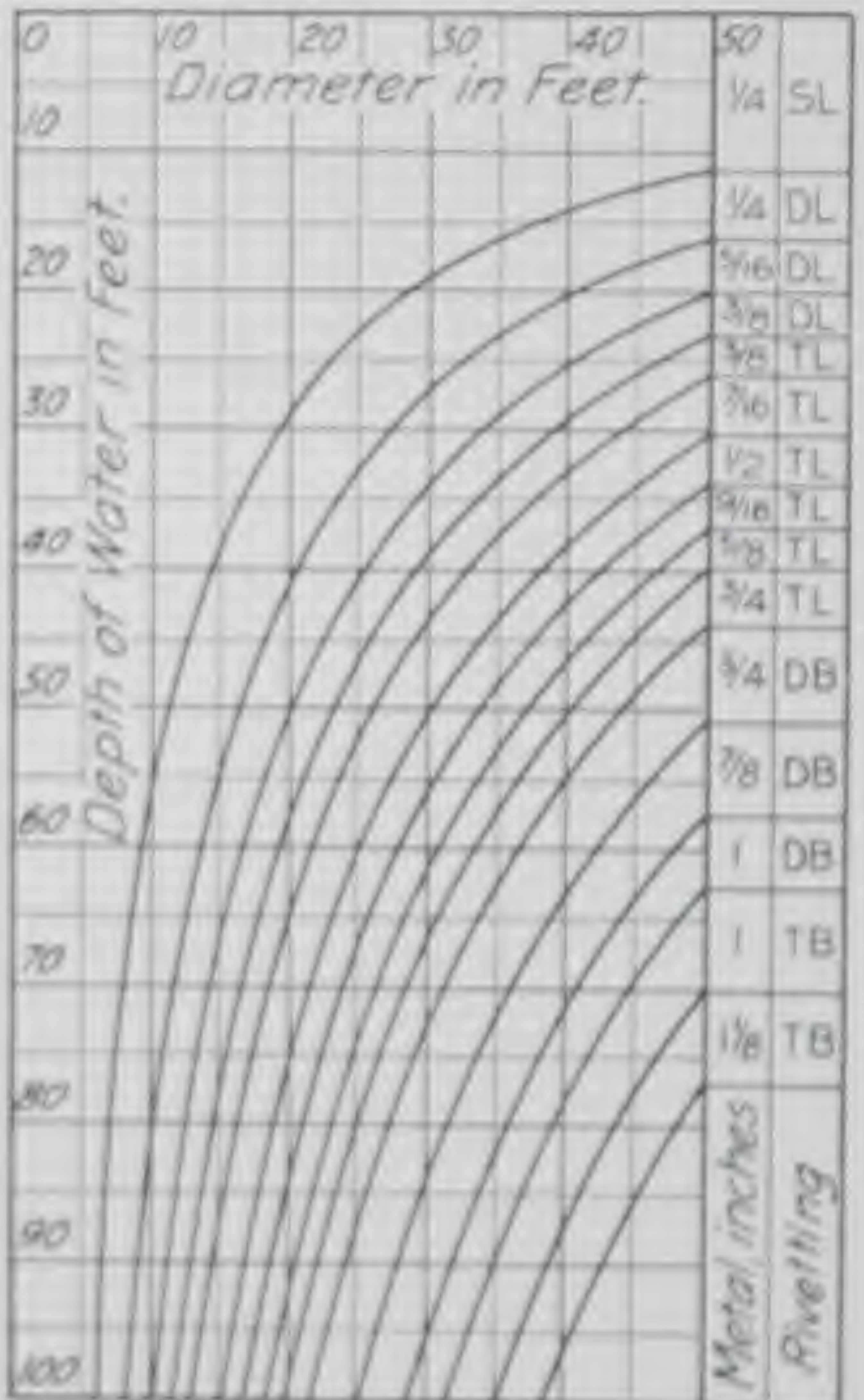
THIS elevated tank, pumping station and reservoir form part of the complete water works constructed by this company.

The products of the Pittsburgh-Des Moines Steel Co. are manufactured in two fabricating shops in the United States, one at Pittsburgh and the other in Des Moines, Iowa, serving the western district. An associated company, the Canadian Des Moines Steel Company Limited, with fabricating shops at Chatham, Ontario handles all work in Canada. The Des Moines plant makes a specialty of general water works construction. A complete stock of water pipe, hydrants, valves and other miscellaneous materials needed for complete water systems is carried. All of the shops are equipped to fabricate bridges, buildings and other similar structural work. The manufacture of elevated steel tanks is concentrated at the Pittsburgh shops, which are equipped with special facilities for this work.

STANDARD TANK DIMENSIONS

Rated Capacity U.S. Gals.	Diam. D	Dist. h	Cylinder C	Rated Capacity U.S. Gals.	Diam. D	Dist. h	Cylinder C
10,000	11'-0"	4'-0"	10'-11"	70,000	21'-0"	7'-7"	21'-10"
15,000	13'-0"	6'-0"	10'-11"	75,000	21'-0"	8'-0"	22'-6"
20,000	15'-0"	5'-5"	10'-9"	80,000	21'-0"	8'-11"	24'-2"
25,000	15'-0"	5'-4"	14'-7"	90,000	21'-0"	8'-0"	28'-4"
30,000	15'-0"	5'-3"	18'-5"	100,000	24'-0"	8'-6"	22'-6"
35,000	17'-0"	6'-4"	15'-7"	125,000	24'-0"	8'-4"	30'-0"
40,000	17'-0"	6'-8"	18'-5"	150,000	28'-0"	10'-5"	24'-2"
45,000	19'-0"	6'-5"	15'-11"	200,000	28'-0"	10'-5"	35'-0"
50,000	19'-0"	8'-0"	17'-7"	250,000	32'-0"	13'-11"	33'-0"
60,000	19'-0"	7'-3"	22'-6"	300,000	32'-0"	15'-0"	40'-3"

TANK & STANDPIPE DESIGN



S=Single D=Double T=Triple L=Lap B=Butt

For designing flat bottomed tanks or standpipes, find point of intersection of depth and diameter lines. This point will usually lie in space between two curves. Follow space upward and to the right and read thickness of metal and type of rivetted joint to be used at lowest ring of shell. Follow diameter line up and change thickness of metal each time said line crosses curves above.

For metal of hemispherical bottoms use only half the thickness given in table. A minimum thickness of ¼" is assumed and governs all area to the left and above top curve.

TOWER DESIGN

FIG. 1

FIG. 2

Lay out tank and tower to scale from dimensions given in table of standard tanks. Fig. 1 represents only two columns of a 4-column tower, and one half of tank.

Assuming wind from left, produce line of column on right to meet horizontal through center of wind pressure on tank. Compute loads as per formulae and draw stress diagram (Fig. 2) to a convenient scale.

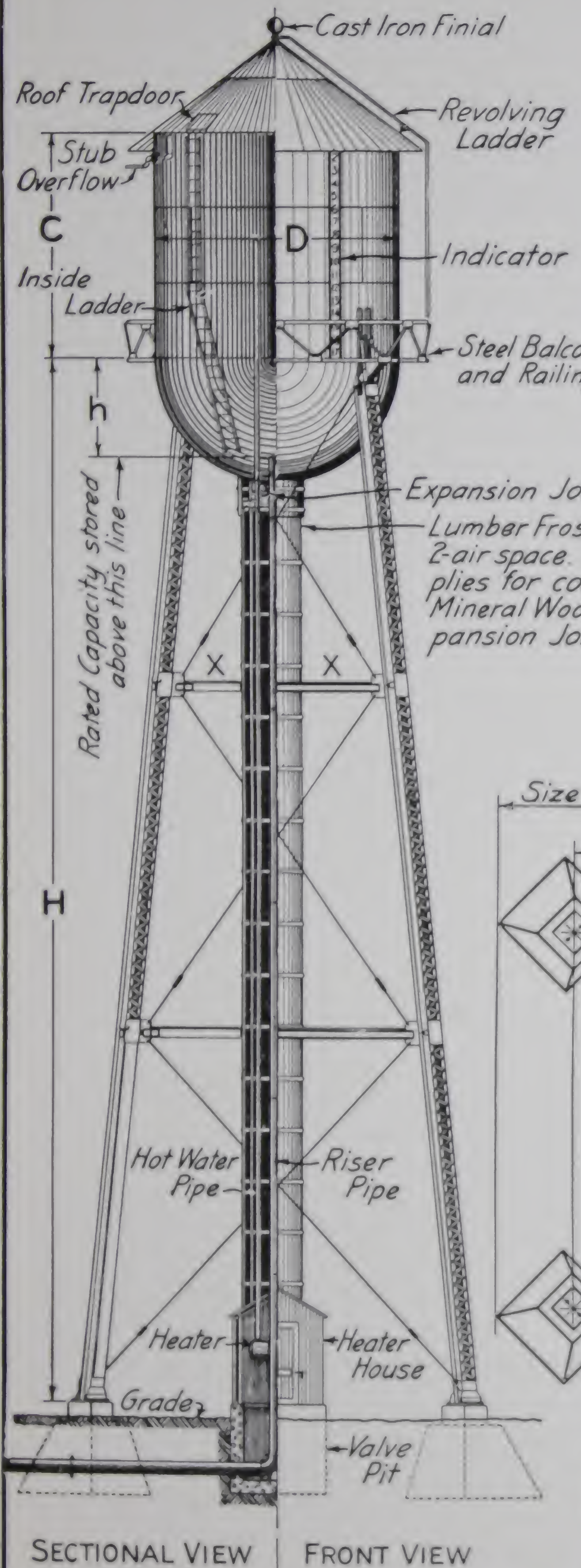
Wind is the only load affecting rods and struts, and maximum stresses are given by diagram. For maximum column wind load multiply diagram stresses by $\sqrt{2}$.

Compute weight of tank and water and estimate weight of tower; one quarter of total is dead load per column. To design column take dead load, and to it add that portion of the wind load in excess of one quarter of the dead load.

Unit stresses for compression members: 12,000#/in² under 90 radii in length, and (17,100 − 57 l/r)#/in² between 90 and 125 radii, except that struts may be 175 radii if load does not exceed half of that allowed by above formulae.

Unit stress for tension members 15,000#/in².

Wind pressure on tank and roof 30#/ft. over six tenths of projected area; on tower, 200# per vertical foot.



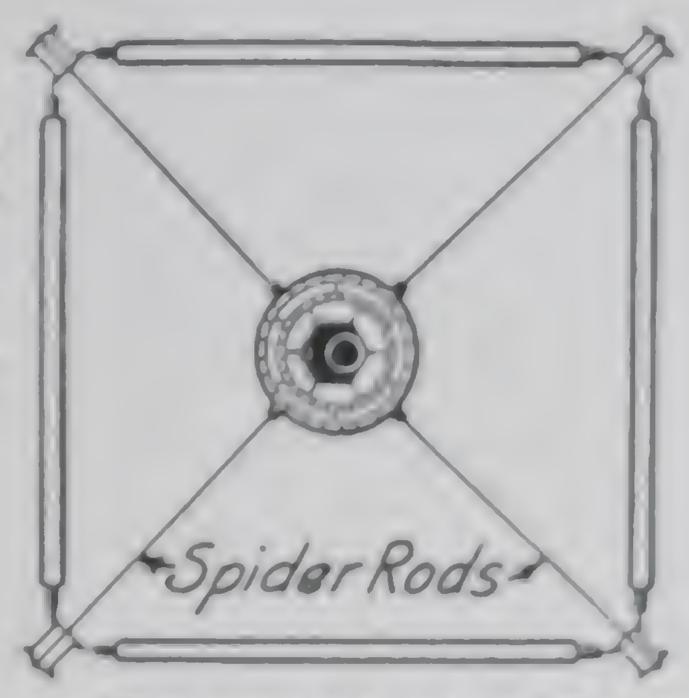
SECTIONAL VIEW | FRONT VIEW

For Municipal Tanks, heater, heater house, hot water pipe and valve pit not required; a small pier is built at base of riser.

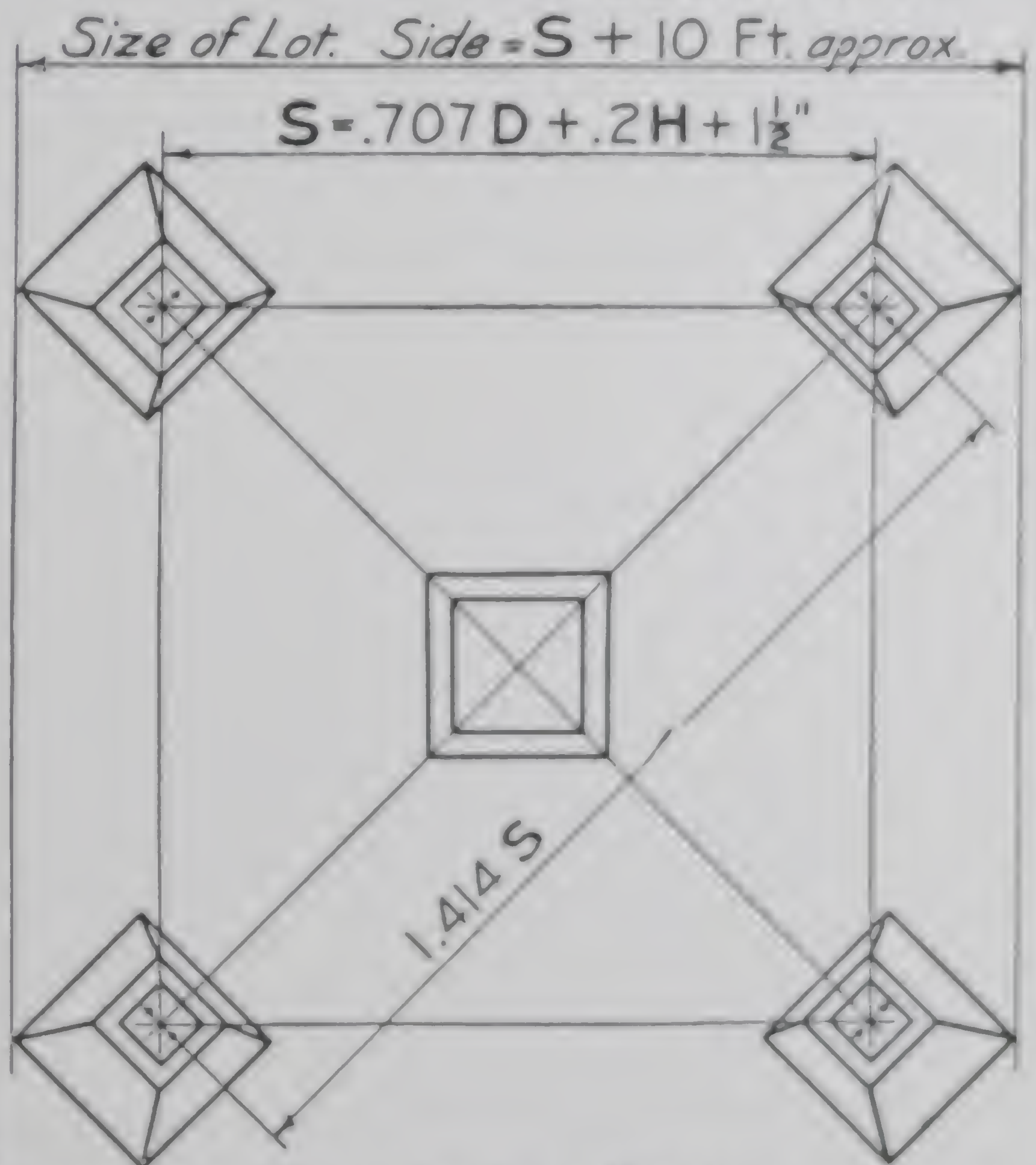
NOTE

*To determine size of lot required for a specified size of tank and height of tower, take dimensions **D** and **h** from table of Standard Tanks; determine **H** and apply in formula below for **S** = spread between adjacent column centers at base. Special Towers can be designed for restricted locations.*

For sizes of tower members and thicknesses of tank plates, send for standard plan.



SECTION AT X



FOUNDATION PLAN

Dimensions of Piers for all sizes of tanks furnished on application.

PITTSBURGH-DES MOINES STEEL COMPANY

Dwg. WX32

How to Use Our Service

THE Pittsburgh-Des Moines Steel Company has offices in important cities listed on page twenty-four, serving all parts of the United States and Canada. A letter addressed to the nearest office will put you in touch with our organization. With no obligation on your part one of our engineers will gladly call on you, determine your requirements, design the structure and quote you a price on the work either erected complete or f. o. b. our shops.

If your requirements are determined, mail your inquiry to our nearest office. State clearly your specifications. In the case of a water tower, the following information should be given:

1. The capacity in gallons.
2. The height of the tower to tank bottom.
3. State which, if any, of the following are included in tank contract, (a) Main Riser Pipe, (b) Frost Casing, (c) Tank Heater, (d) Underground Piping and Valves, (e) Concrete Foundations.
4. The erection conditions at the site. Distance to nearest railroad siding. If erected on a building give the number of stories and dimensions and spacing of the supporting columns.

A Suggestion

IF you are interested in any of our products or if we may be of service to you in furnishing plans and specifications on any of our standard steel structures, mail the enclosed card outlining your requirements.

Steel Building

These are examples of steel construction fabricated and erected by this company. Inquiries are solicited for furnishing and erecting steel for public buildings, hotels, mills and office buildings, barges, coaling stations and other standard steel structures. A complete stock of structural shapes, plates, bars, angles and reinforcing rods carried in our shop for immediate shipment.

Gold Dredge

PITTSBURGH-DES MOINES STEEL COMPANY

Sales Offices

PITTSBURGH, PA. . .	713 Curry Bldg.
NEW YORK, N. Y. . .	50½ Church St.
DALLAS, TEX. . .	1227 Praetorian Bldg.
SAN FRANCISCO, CAL.	315 Rialto Bldg.
CHICAGO, ILL. . .	38 S. Dearborn St.
WASHINGTON, D. C.	990 Munsey Bldg.
DES MOINES, IOWA . . .	930 Tuttle St.

Shops

PITTSBURGH, PA. DES MOINES, IOWA

Canadian Branch

CANADIAN DES MOINES STEEL COMPANY, Ltd.
CHATHAM, ONTARIO . 330 Inshes Ave.